Minnesota Methamphetamine Risk Model: Predicting an Epidemic and the Temporal and Spatial Correlation to Crime Levels

Eric T. Wyffels
Department of Resource Analysis, Saint Mary's University of Minnesota, Minneapolis, Minnesota 55404.

Keywords: GIS, Methamphetamine (Meth), Clandestine Labs, Uniform Crime Reports (UCR), Census Data, Demographic Factors, Meth Events (ME's), Hot Spot Analysis

Abstract

The following research was undertaken to provide information and data supporting an analysis of the impact Methamphetamine production and abuse is having on crime rates at county levels throughout the State of Minnesota. Thirty percent of methamphetamine abuse is currently produced in clandestine labs, which tripled in numbers from 2000 to 2003, and are generally discovered and seized in rural and semi-rural areas, more often than in urban areas. Providing GIS findings regarding historical Meth lab locations and patterns, this paper identifies potential "Hot Spots" and crime-troubled counties in hopes of mitigating negative effects of methamphetamine in the State. The Minnesota Methamphetamine Risk Model incorporates demographic census data (2000), changes in crime rates from 1999 to 2005, and selected high-risk crime areas to determine correlation between Methamphetamine and crime.

Introduction

What links exist between Meth and crime? To answer this question, a solid understanding of Meth, its manufacture, and its effects on the human mind, both physically and psychologically, is required. Behavior, in the form of supercharged aggression, paranoia, hyper-sexuality power confidence, and a total lack for one's own well being and self respect are typical of Meth users, whether a veteran or novice.

The onslaught of Meth from West to East across the nation has a participating audience of 12 million American users. The users account for 22% percent of all drug arrests and 2000 lab fires annually (Johnson, 2005).

The following study will examine the link between Meth and various crimes. An overview of previous research to analyze drug use, related crime, and causal affects, will be outlined in an attempt to determine what can and cannot be achieved using crime statistics and geographic information. Also, an important base must be built from the understanding of the nature of Meth, its production (labs), and effects of the drug upon its dependents. The state and "hot spot" county level impacts of Meth will be evaluated, developing a premise that the location and timing of Meth Events or ME's (labs, vehicles, dump sites, and ammonia thefts) are strong indicators of specific crime rates increasing.

A statewide risk model was created based on collected criminal and socio-demographic census data, as weighted factors in determining "hot

Eric T. Wyffels. 2007. Minnesota Methamphetamine Risk Model: Predicting an Epidemic and the Temporal and Spatial Correlation to Crime Levels. Volume 9, Papers in Resource Analysis. 24 pp. Saint Mary's University of Minnesota Central Services Press. Winona, MN. Retrieved (date) http://www.gis.smumn.edu

spots." The data is supported by Uniform Crime Reports, previous studies and research, as well as Census 2000 data. Information was garnered from government agencies, treatment and admission facilities, conferences, and verbal presentations. Subsequent to the development of the risk model, an exercise in validation will constitute the next action. Lastly, a final analysis between Meth and crime may yield findings and discoveries, which will be contrasted with similar studies performed by academics and law enforcement personnel (Butler, 2000).

Methamphetamine

Methamphetamine is often referred to as "crystal," "crank," "speed," in low grade form and "ice" or "glass" in its purest form. The drug has many legitimate medicinal uses and has been commonly prescribed by physicians since the 1930's to treat asthma, overeating disorders, Parkinson's disease, narcolepsy, and Attention Deficit Disorder (ADD) (Mills, 1999).

Meth can be snorted, injected, inhaled, or ingested when dissolved in a liquid and it immediately causes the brain to create an excessive amount of the neurotransmitter dopamine, which in naturally regulated amounts facilitates critical brain functions. Dopamine, when released in excessive amounts produces a feeling of extreme euphoria. Meth users report that they experience an increase in energy, alertness, self confidence, and power (Clark, 2005).

In Minnesota, approximately 750 Meth labs have been dismantled and detoxified from 1998 to 2003. Meth has been a growing problem since the mid-1990's, with statistics rising to 5,886 people seeking treatment (PST's) for Meth addiction in 2004.

Between 20% and 30% of Meth is produced in clandestine labs, while 70% to 80% comes from out-of-state or other nations, such as Mexico. Across Minnesota, Meth is being "cooked" in "Mom & Pop" or "Beavis & Butthead" labs found in houses, apartments, cars, day-care centers, tents, buried school buses, duck blinds, deer stands, and ice-fishing houses (Johnson, 2005). The BCA estimates there may be as many as 10,000 labs of various forms in operation across Minnesota. Atypical of most drugs, Meth production usually starts in rural and semi-rural areas of the state due to the privacy provided by the greater distances between residences and leaner law enforcement units. Recently, the drug has been shifting to more suburban areas. "There is no county in Minnesota that Meth is not being used and made," said Deb Durkin, a senior environmental scientist with the MDH (Durkin, 2006).

Minnesota based Meth activity doubled between 2002 and 2003, while incarcerations for drug offenses rose from 14 % in 1996 to 38% in 2002. In 1996, 48 % of drug offenders were sentenced to prison due to cocaine, compared to 14% for all amphetamines. By 2002, cocaine was responsible for 40 % while Meth and amphetamine offenders had grown to 38% according to the state sentencing guidelines commission (ONDCP, 2005).

Another disturbing statewide trend is that of child endangerment, abuse, and neglect in Meth settings. Authorities estimate that children are found at 40% to 50% of Meth labs (Shroyer, 2005).

Table 1 indicates the number of Meth lab seizures (ONDCP, 2005).

Table 1. Clandestine Lab Seizures.

Year	Number of Lab Seizures
2000	123
2001	154
2002	242
2003	301
2004	96

Methamphetamine – Crime Link

Excluding the crimes of possessing and/or trafficking methamphetamine, the larger concern is associated with violent crime, assault, sex abuse crimes, theft or burglary providing the funds for ingredients and precursors required for cooking Meth, and of all things, identity theft and fraud.

Alsobrooks (2002) claims there is "an undisputable correlation between drug use and crime, and it is obvious that the combination of increased availability of drugs and a decrease in the stigma for drug use will result in an increase of crime."

A survey conducted by Kyle and Hansell (2005) on the criminal effect of Meth on communities suggests Meth is a growing problem that is now of national scope. Of 500 responding law enforcement agencies, 87% reported an increase of Meth related arrests starting in 2002. Meth is the leading drug related local law enforcement problem in the country. Fifty-eight percent of counties polled revealed that 20% of their current inmates were housed as a direct result of Meth-related crimes. Seventeen percent of counties reported that more than 50% of their populations are incarcerated because of Meth-related crimes. Spin-off crimes are increasing as a result of Meth abuse. Seventy percent of the responding authorities say that robberies and burglaries have increased because of Meth use, while 62% report increases in domestic violence. Assaults rose by 53%, and identity thefts increased by 27%.

Determining Hot-Spots

Prior to any subsequent "Hot Spot" GIS analyses, general maps showing the statewide ME distribution from 1999 to 2005 were created to illustrate Hot Spot locations. By creating two dot density maps, one based on Meth Events (ME's) per county and the other being ME's per Zip Code Tabulation Area (ZCTA), three potential Hot Spots were identified for further analysis. Figure 1 shows a graphic of the ZTCA-based dot-density map, which proved to be the more useful of the two maps when determining key hot spots. This is due to the fact that ZCTA's are much smaller area units than counties and dots are placed randomly within the border of the area.

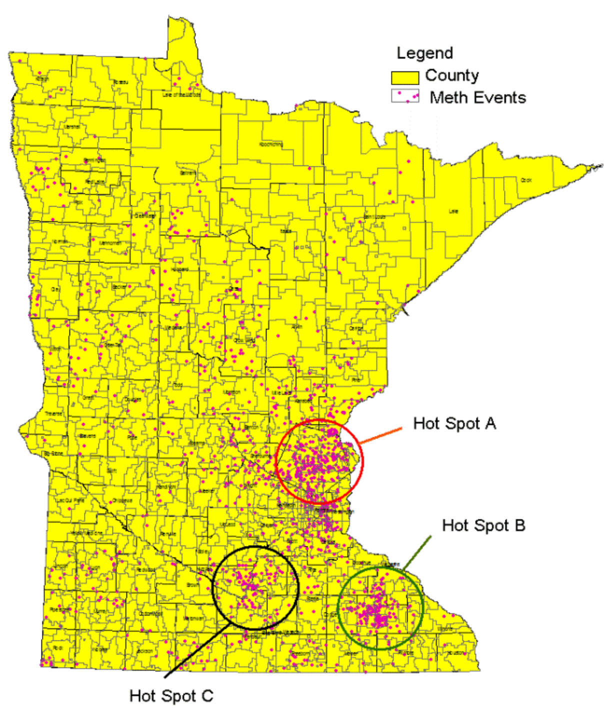

Figure 1. Dot Density of Meth Events per ZCTA.

The data, methods, and procedures for analysis are outlined in subsequent sections.

Demographic Risk Model Factors

The demographic risk factors (RF's) are based upon information from the TEDS, Treatment Episode Data Sets (SAMSHA, 2006), the Illinois State Meth Model (Butler, 2000, ISP, 1999), the ONDCP (2005), and an article by Kim Mills (2003), Seattle Post.

RF-1: Avg. Drive Time to Work per County

Because a majority of Meth abusers and "cooks" tend to be blue-collar or service workers, these people tend to live on the outskirts of the cities and commute for work as outlined in Figure 2. Blue-collar workers are typically outdoor sports minded people. Therefore they tend to live in semi-rural or rural areas leading to a longer drive to the place of work generally located in a nearby city or metropolitan area.

Service workers on average make less than the median pay rate and typically cannot afford suburban or urban rental costs. In addition, studies show that average drive times compared to ME's led to the conclusion that a fairly strong correlation exists between the two datasets. This factor was given less weight in the model due to the fact that 58% of Meth users were unemployed per the Washington State Division of Alcohol and Drug Abuse (Mills, 1999).

RF-2: Percent Change in Overall Crime Rate (OCR) per County

Figure 3 references the overall crime rates (OCR) between 2000 and 2005.

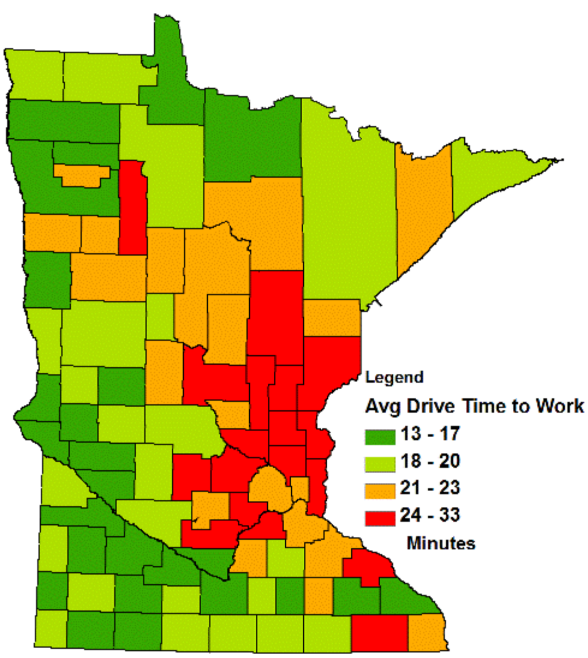

Figure 2. Average drive time to place of employment per county, 2000.

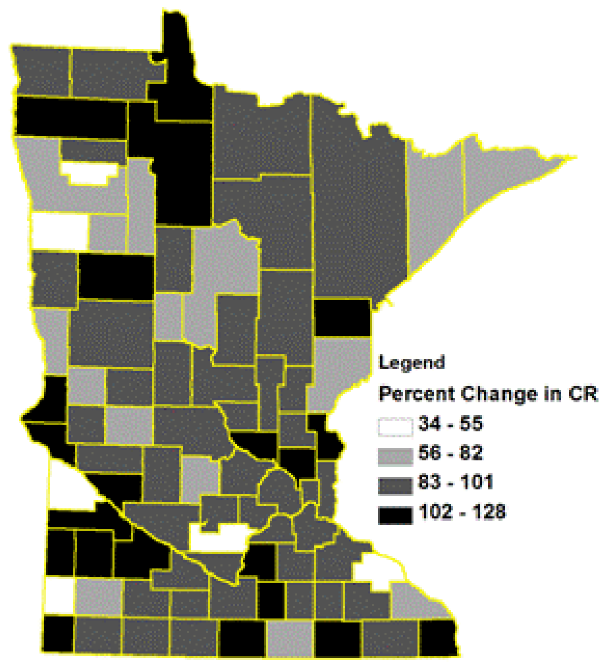

Figure 3. Percent change in overall crime rate (OCR) per county, 2000 to 2005.

High crime rates and drug use usually correlate. This theory is based on various law enforcement studies over the years (Butler, 2000). The three most important causal links between drugs and crime are the 1) behavioral effects of drug use, 2) the monetary need for addicts to support their habits and 3) the side effects of illegal drug markets (Boyum and Kleiman, 2003).

RF-3: Percent Change in Narcotics Crime Rate (NCR) per County

Paul Stevens (2005), a former DEA director, states that 33 percent of arrestees in Minnesota have prior convictions of Meth or cocaine related offense. Reported Meth activity in Minnesota doubled from 2000 - 2003 and drug related prison sentences jumped 14% (1996) to 38% (2002) as illustrated in Figure 4 (Becker, 2004).

The overall crime rate is calculated as the number of persons committing Part I and Part II offenses per 100,000 people, collected at the county level as an aggregate of city and town data, and sheriff's offices in more rural areas.

RF-4: Urban-to-Rural Characteristics per County

In the risk model, a code from "1" to "4" was applied to represent the severity of the threat based on rural vs. urban characteristics. Figure 5 provides a threshold map of urban and rural weight factors as defined below. The semi-urban counties, defined as having a 50-80% urban population, were assigned a "4" representing the most weighted threat, and rural counties assigned a "3" weighted as somewhat less of a threat, having less than a 20% urban population. Furthermore, semi-rural

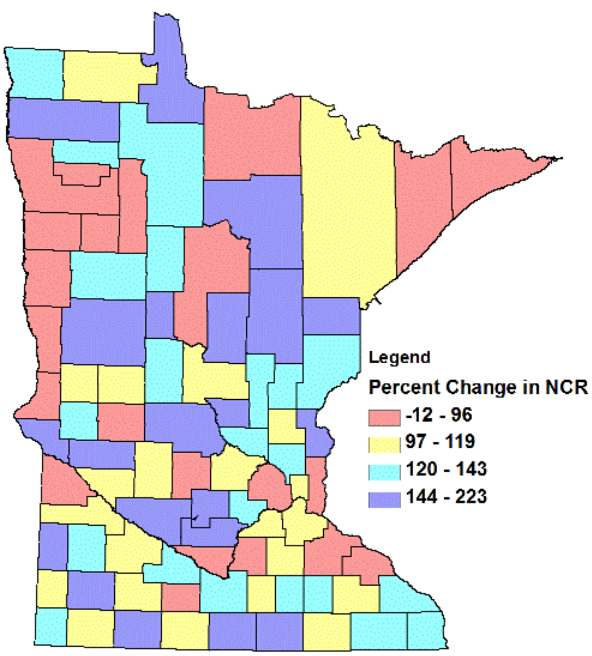

Figure 4. Percent change in narcotics crime rate (NCR) per county, 2000 to 2005.

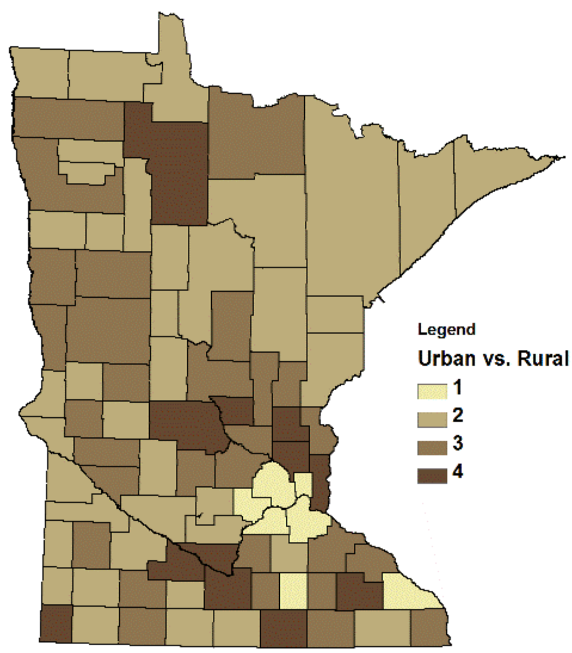

Figure 5. Percent urban vs. rural per county, 2000.

counties were categorized as 20-50% urban, and assigned a "2," having even less of a risk in the model. Finally, urban counties were defined as areas having an 80% plus urban population, and assigned a "1," being the least threatening on the risk model.

RF-5: Population 25 yrs or-older, with No High School Diploma per ZCTA

Blue-collar workers comprise a majority of the Meth offenders, especially those that are considered more likely to have less than a college degree education (ISP, 1999). Per the Illinois database of People Seeking Treatment, the average educational level is 11.3 years, indicating a lack of a High School degree (Butler, 2000). Figure 6 illustrates the percent of population lacking a high school diploma.

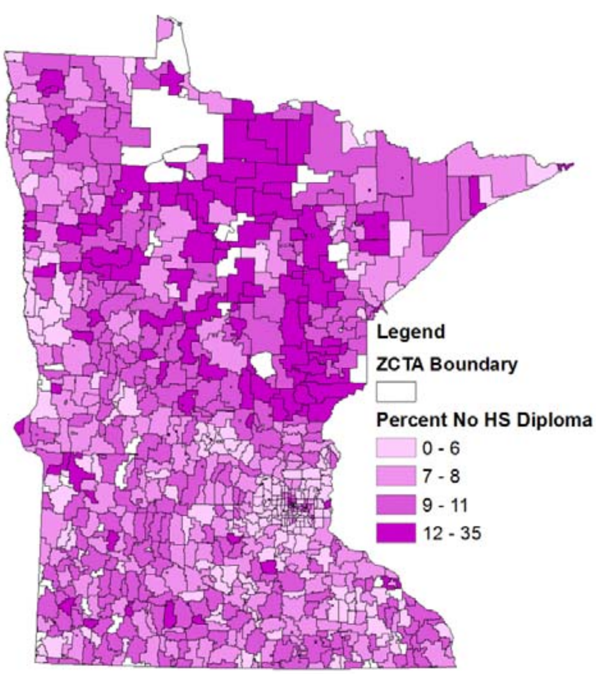

Figure 6. Percent of population over 25 years of age with no high school diploma (ZCTA), 2000.

RF-6: Population 25 to 34 years-old per ZCTA

The People Seeking Treatment database states that the average age of a Meth inflicted person is between, and or close to, the age bracket of 28.3 to 32.1 (Butler, 2000). The Office of National Drug Control Policy (ONDCP) reports that most Meth users are over the age of 26, while 76% are 21-40 (Mills, 1999). The age bracket utilized throughout this study is 29 to 34 years old, a clear bracket within the census data, and is the age group exhibited by Figure 7 as a percentage of population of all ages. The differences between male and female are uncommonly irrelevant compared to those statistics between male and female for other drugs, such as heroine or cocaine.

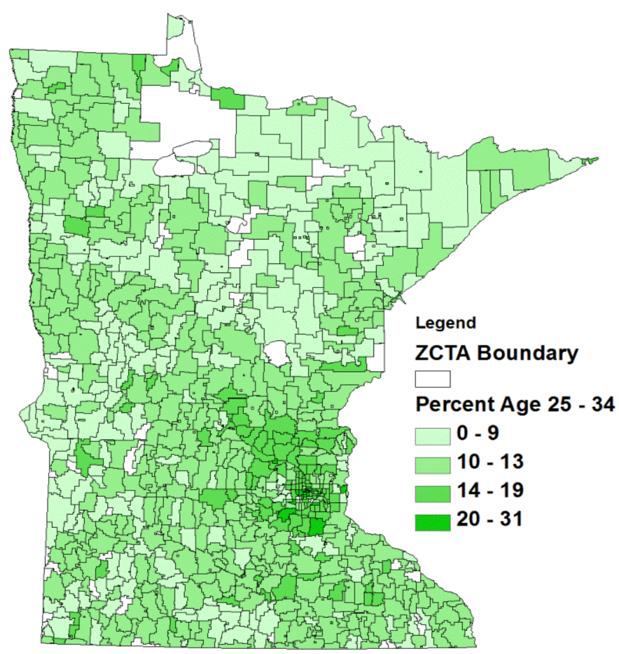

Figure 7. Percent of population 25 to 34 years of age (ZCTA), 2000.

The breakdown of male to female is 57% to 43%, or nearly 50:50 across the nation, primarily because Meth is used as an effective weight-loss product by women; men use the drug to support and perpetuate the "super-man complex" affects of the narcotic (ISP, 1999).

RF-7: Percent of Caucasians per ZCTA

The Illinois People Seeking Treatment and the Arrestees/Suspects Databases indicate that the vast majority of Meth users are white (Caucasian), 92% and 100% respectively. Figure 8 displays the distribution of Caucasians throughout the state. The ONDCP provides data that shows that the majority of meth-amphetamine users are Caucasian (Butler, 2000). About 75% of TEDS admissions were white males over a five year period (SAMHSA, 2006). Thirdly, the Washington State DASA reports that from July 1998 until July 1999, 91% of the persons seeking treatment were white (Mills, 1999).

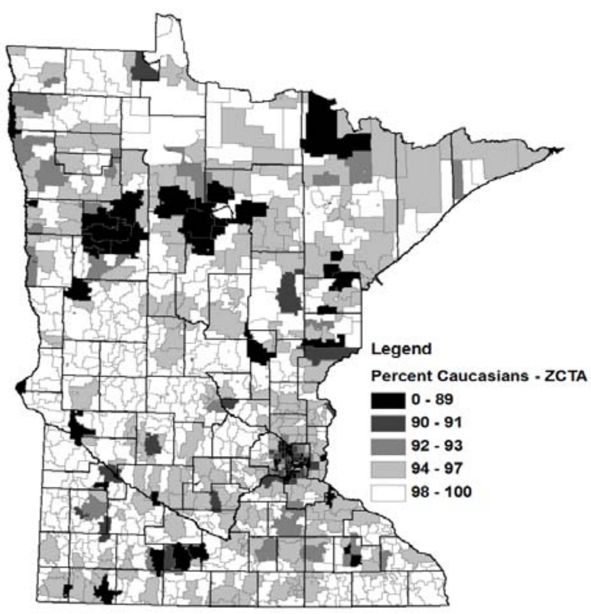

Figure 8. Percent of population of Caucasians as a percentage of all races (ZCTA), 2000.

RF-8: Population Living Below the Poverty Level per ZCTA

Poverty levels of Meth users and cooks, as displayed in Figure 9, were set at \$19,644 a year in 1990 and \$20,819 a year in 2000 (Butler, 2000). Poverty was weighted heavier in the Risk Model in comparison to many other ZCTA factors, although other ZCTA factors not utilized here have a strong correlation to ME's, such as unemployment (Johnson, 2005). After all, Meth is coined the "poor man's cocaine" and is less costly than cocaine, crack, PCP, LSD, and heroin. Paul Stevens (2005) reports that the price of 30% purity Meth is fairly affordable to users who typically pay \$100 to \$300 a gram. The more pure and potent "Ice" sells for around \$500 to \$600 a gram.

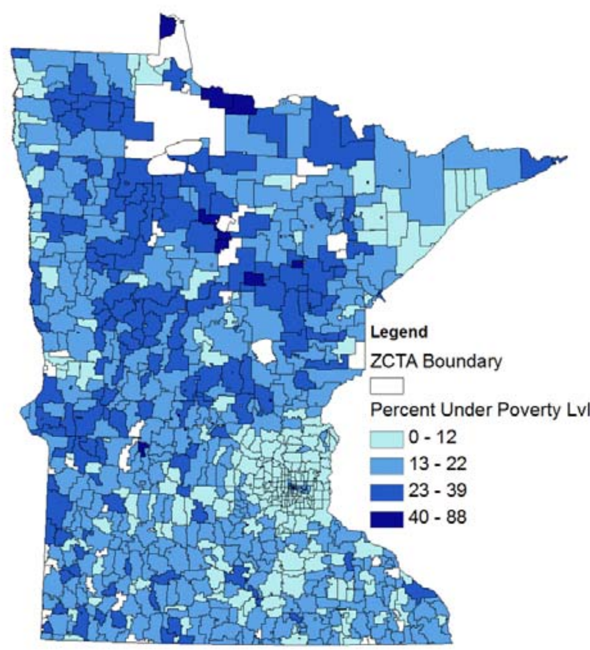

Figure 9. Percent of population living below the poverty level (ZCTA), 2000.

RF-9: Population 25 Years old and Unmarried per ZCTA

The People Seeking treatment database (ISP, 1999) yields that 79.8% of the Meth offense implicated individuals have been divorced, separated, or never married. Furthermore, unmarried individuals were present at 67% of Meth lab busts. The distribution of unmarried individuals over 25 years of age is presented in Figure 10.

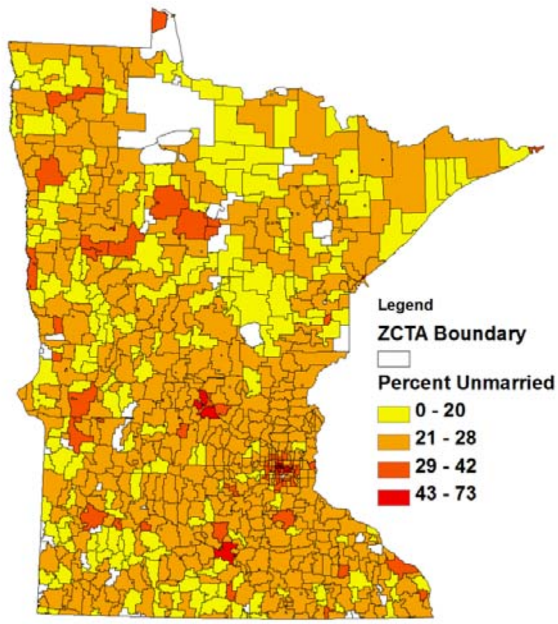

Figure 10. Percent of population that are over 25 years old and unmarried (ZCTA), 2000.

Crime Analysis

The two key components utilized during the crime analysis phase are 1) the Lab Events database and 2) the series of Uniform Crime Reports (UCR's) spanning from the year 2000 until 2005. The databases synchronize temporally across the six year window, with the exception of minimal data from late 1999 being included in the year 2000 totals for ME's in the case of the Lab Events database.

Data, Procedures, and Observations

Data and Preparation

The Events database, as outlined in Table 2, was utilized during the development of statewide dot-density maps. Additionally, subsets of data were sorted by date, county, and zip code. The database, in MS Excel file format, contained 80+ entries that were incomplete, inaccurate, and simply unusable. The ME entries that did not have complete county descriptions and 5-digit ZCTA numeric information were deleted. The remaining entries, approximately 1244 in number, were subjected to a thorough normalization process, eliminating questionable ME locations that would eventually hinder geocoding Hot Spot ME locations. The following fields comprise the database:

Table 2. Lab (Meth) Events Table Columns.

Column - Description	Format
A. Type of Event	Coded 1-8
B. Date Lab Seized	xx/yy/zzzz
C. Type of Housing Unit	Multiple/Single
D. Street Level Address	Std. - Text
E. City Name	Text
F. County Name	Text
G. ZCTA	5-digit Number
H. Latitude, Longitude	Std. Lat-Lon.
I. Production Method	Nazi/Red-P

While further normalizing and standardizing revisions of the Lab Event database, the following steps were incorporated: 1) the text formatted date column was copied, converted into the serial date format using an Excel function, and inserted, 2) the street address information was spell-checked and standardized, 3) any missing county data was geo-located based on the existence of street addresses, city names, and/or zip codes and entered, 4) and the latitude, longitude, drug type, and production method columns were deleted to minimize excess data.

During the crime analysis phase, the cleaned database was utilized for performing counts of ME's per ZCTA and County. The total number of ME's located in each of these types of geographic units were initially used in the preliminary identification of Hot Spots. Later, during the GIS Analysis phase, the correlation levels between the number of ME's per County and ZCTA's enhanced the credibility of assigning "weights" to demographic risk factor layers, which are ultimately incorporated into the Risk Model.

UCR Reports (2000 to 2005) were obtained through the National Institute of Justice website (CJIS, 2006). The reports required manual extraction of data into software for analysis. Two specific crime data sets were processed for the 87 counties of Minnesota, 1) the Overall Crime Rates per county and 2) the Narcotics Crime Rate per county for years 2000, 2003, and 2005. The 2007 data for both the Overall Crime Rate and Narcotics Crime Rate was extrapolated using the Excel TREND function. The data was then used in determining the percent changes for two of the necessary risk factors for the Statewide Meth Risk Models, those being RF-2: Percent Change in the Overall Crime Rate per County, and RF-3: Percent Change in Narcotic Crime Rates per County. The percent change for both factors was determined by averaging the known data of the years 2000, 2003, and 2005 and dividing the result by the predicted crime rates of 2007.

The crime data needed for analyzing Hot Spots A, B, and C extends over the time period from the year 2000 to 2005, and encompasses seven types of Part I and Part II crimes: Burglary, Rape, Aggravated Assault, Other Assaults, Forgery/Fraud, Other Sex, and Family-Children offenses.

Crime rates for years 2006 and 2007 were projected using extrapolation techniques. The ME's annually reported in each of the 9 counties comprising the three aforementioned Hot Spots, were added to the spreadsheets. Due to the unavailability of data, the quantities of ME's per county per year were approximated using a limited 3 month based TREND function – as was the crime date – for 2006 and 2007. Because 2003 was such a peak year for ME's across the State, the extrapolations would be skewed if the years 2000 through 2003 were used in determining the ME quantities for 2006 and 2007. The counterfeiting and forgery crime rates were combined with fraud rates and placed into a single category due to the crimes being analogous. Narcotic crime rates are excluded from this section of the study based on the strong correlation of Narcotic-related crime to the Meth Event numbers and very little could be learned from such an analysis.

Procedure

The analysis used in determining the link between ME's and crime rates at the county and Hot Spot level consisted of 1) determining the percent change in overall crime rate (OCR) and narcotics crime rate (NCR) per county, 2) inserting the number of ME's as an additional column, 3) calculating a Meth Events crime rate (ME's per 100K population), or MECR, and 4) using the CORREL function in Excel to perform linear regression on the resulting arrays of data. The correlation coefficients between the following arrays were determined for all counties as illustrated in Table 3.

Table 3. County Level Correlation Coefficients.

Array, description	Corr. Coeff.
% change OCR to NCR	.312
% change OCR to # ME's	.136
% change NCR to # ME's	.007
% change OCR to MECR's	.106
% change NCR to MECR's	.264

The crime data for Hot Spots A, B, and C were compared to the overall counties data by determining averages for the percent changes in OCR, NCR, number of ME's, and MECR values for each geographic unit. In addition, the average ME's per 100,000 persons per county and Hot Spot were calculated. Correlation coefficients for specific crimes per Hot Spot to ME's were also determined, which will be used in the following analysis. Refer to Appendix A and B throughout the following observations section for tabular data.

Observations

All Counties

Statewide, county level correlation coefficients are fairly strong on the positive side, at .312, between the percent change in overall crime rate and narcotic crime rate. This is to be expected as the NCR is a subset of the OCR and the arrays are essentially an "apples-to-apples" comparison. The percent change of OCR to the number of Meth Events is slightly weaker, but still positive at .136, and not a surprise as the correlation is an "apples-to-oranges" type of relationship. The correlation coefficient of the percent change of narcotics crime rate to the number of ME's Events resulted in .007. The correlation of percent change of OCR to the Meth Events crime rate, MECR, is somewhat statistically significant at .106, and is based on comparing arrays of similar units. The fact that percent change of Narcotics CR to the Meth Events CR coefficient is a positive .264 is a reflection of the population (per 100,000) being a component of both measures, and slightly more significant than the previous OCR to MECR findings because the NCR is more focused on drug related crimes.

Through statistical comparisons, the data contained in the Correlation Coefficient table tells us that:

- The relationship between the OCR and NCR is strong and expected.
- The %Chg OCR to the number of ME's is loosely correlated.
- The %Chg NCR to the number of ME's is, for all practical purposes, zero, and is probably due to comparing unlike units.
- The %Chg OCR to the MECR is significant, but lower than expected because the OCR has dropped on average over the time period analyzed, while the MECR peaked in 2003 and then dropped by 2006.
- The %Chg NCR to the MECR is more significant due to Meth-related crime comprising a larger percentage of all narcotics related crime.

All Counties to Hot Spot Counties

The analysis of all counties to Hot Spot (HS) counties finds the following:

- The OCR of HS counties, is higher at 7966 than all counties, 7361. This contributes to the theory that Meth generally increases CR's.
- The narcotic crime rates of 299 for all counties and 294 for HS counties are statistically equivalent, due to the 7 metro area urban county NCR's skewing up the average of All state counties in addition to the NCR's being comprised mainly of possession offenses – most of which are marijuana and an equivalent part of cocaine to that of Meth.
- The percent change in OCR's of All Counties at 90% compared to HS counties at 95% indicates that the OCR is dropping for most statewide counties at a greater rate than the HS counties.
- The percent change in narcotic crime rates is increasing faster at 117% for All Counties compared to a slightly slower pace of 108% for HS counties.
- The ME's for the HS counties outnumber the ME's for All counties, 57 to 15. If this was not the case, the selection procedure for determining Hot Spot counties may have been flawed. The MECR's are also higher for HS counties, 108 v. 44, based on the higher average number of ME's and lower mean population levels found in HS counties. The number of Meth Events per 100,000 persons follows the same logic: 84 for HS counties and 26 for All Counties.

Specific Crime Rates of HS Counties

Some trends and conclusions can be made based on the derived crime, ME information, and correlation coefficients as contained in Table 4 and summarized in Appendix B. For each of the seven categories of crime and crime rates, a correlation of each crime type to the ME's was determined over the 8 year period, determining "same" year (0), "leading" (-1) year ME to CR, and "lagging" (+1) year ME to CR correlation coefficients. Each crime type and coefficient is evaluated as shown in Table 4.

Table 4. Crime Correlation Coefficients to ME's.

Crime (Part I, II)	**-1 yr**	**0- yr**	**+1 yr**
Rape (I)	.588	.252	.194
Aggr. Assault (I)	.231	.583	.227
Burglary (I)	.607	.840	.079
Other Assaults (II)	.384	.234	.292
Fraud/Forgery (II)	.445	.000	.571
Other Sex (II)	.137	.520	.183
Family/Child (II)	.162	.789	.945

GIS Analysis

The GIS analysis for Meth Events and Risk Model development was performed at two different scales. The smaller scale is represented at the State level. The geography was further subdivided down into two subsets: 87 Counties and 848 Zip Code Tabulation Areas (ZCTA's) within the State of Minnesota. The larger scale areas of study consist of three coterminous counties and corresponding ZCTA's, and are referred to as "Hot Spots" A, B, C. The GIS software utilized for map making and analysis was ArcGIS ArcView 9.0 (ArcMap) and the Spatial Analyst extension. Microsoft Excel was used for data preparation, analysis, and formatting for use in ArcView.

The goals of the GIS research were to 1) develop and validate a statewide Risk Model, incorporating nine demographic risk factors that are indicative of the use and lab production of Meth and 2) to perform an analysis of the three Hot Spots yielding new information as to the number, distribution, pattern, clustering and relative geographic locations to other features/crimes of the Meth Events.

Data and Procedures

Data

Datasets collected, processed, and added to maps consisted of the data represented in Table 5.

Table 5. GIS Datasets.

Dataset	Source	Format
Lab Events Database	MDH	.xls
County Factor Table	LMIC	.cvs .xls-
ZCTA Factor Table	LMIC	.cvs –.xls-.
MNDOT County	LMIC	shapefile
ZCTA Base Map	LMIC	shapefile
Roads	LMIC	shapefile
Major Roads	LMIC	shapefile
Ammonia Thefts	MDH	shapefile
Geocoded ME	MDH	shapefile

Procedure

The initial step in developing the dot-density maps consisted of adding the Zip Code and Counties shapefiles.
The two tables were "joined" to the attribute .dbf tables of the ZCTA and County spatially referenced shapefiles, respectively.

The dot-density maps were created using similar methods. In the Properties Layer box, the type was set to Dot-Density, the layer properties symbology characteristics were assigned a value field, and the number of ME's in both cases. By setting the Dot Value to one, the actual number of ME's was randomly placed in ZCTA's and Counties across the State.

Hot Spot maps were created by "clipping" the Roads layer to the selected counties layer. Geocoding of ME's was accomplished by setting up a geocoding service, selecting a reference table with address data, and running the geocoding process against the target address table. Manual re-matching was often necessary for unmatched addresses in the case of poorly standardized or incomplete data in either the reference address table or the target table.

Hot Spot Analysis

The definition of a Hot Spot is a concentrated number of crimes occurring within a limited geographic region, sometimes on a repeated basis. Typically, Hot Spot analysis is concentrated on specific types of crimes, such as burglary or assault, in a confined environment. The Hot Spot analysis performed here tends to be slightly more homogeneous in the sense that ME's of various types were mapped prior to the high risk zones being determined. However, the independence of the Risk Factors from the ME's is maintained due to the fact that the ME occurrences are not inclusive to the Risk Model, allowing for the production of an objective and indiscriminate risk model.

Per the National Institute of Justice (NIJ, 2005), Hot Spot determination can be accomplished in many ways, but whatever method is chosen, it must support the goals of the analysis.

First, these goals must be defined. The goals of this study were further refined and are A) to analyze 3 key Hot Spots at a tri-county level, B) to compare and contrast point clustering and patterns between the hot spots, C) to analyze the hot spot locations and ME points in relation to each other, highways, major metropolitan areas, key cities within the hot spots, D) to test the validity of the Risk Model, E) to analyze the crime rates of specific offenses within the hot spots to evaluate the impact of Meth on these rates, and finally F) to draw conclusions from interfacing hot spot, crime rate, and risk model data.

Second, appropriate geographic units and overall areas of study must be determined. The three area units used for the study at hand, from smallest to largest, were ZCTA's, Counties, and State. The state level was evaluated giving a big picture display of the distribution of Meth events. The hot spots were extracted from the statewide dataset analysis so that the crime data pertinent to the associated county was manageable and could be processed. To simplify, the crime analysis in the high risk Meth areas is relevant because the only way to isolate the Meth-Crime association is to further analyze areas that are primarily affected by Meth activity as opposed to other factors like unemployment or other drug abuse.

Third, a method for identifying hot spots must be chosen to select the prime candidate locations for more in depth Hot Spot analysis. Initially, a simple clustering test was chosen in the form of Dot-Density maps at the ZCTA and County aggregate levels to choose the prime candidate locations for more in depth Hot Spot analysis. Next, a kernel density map was created from ME point data, as geocoded in Hot Spot A shown in Figure 11. Hot Spot B analysis was created using a simple density map, finally, Hot Spot C utilized a simple visual interpretation method of point distribution, but performs an additional step of separating ammonia theft data from other ME's into another subset. The ME's within a specific distance of the ammonia thefts are selected and a new shapefile was created. By using several methods of analysis, it is possible to differentiate and compare the maps and expose the results from alternative perspectives. The observations of each Hot Spot analysis were used as part of the Final Analysis.

Hot Spot A

Counties: Anoka, Chisago, and Isanti.
Key Cities: Forest Lake (pop. 6,798), Stacy (pop. 1,278), North Branch, Chisago City.
Total Counties Population: 399,068
ME's: 249 as illustrated in Figure 11.
Geocoded and Matched: 225
Geocoded and Unmatched: 24
Successful Geocoding Percent: 80%
Major Transportation Routes: I-35, I-35E, I-35W, I-694, US-10, and US-169
Nearby Waterways: St. Croix River

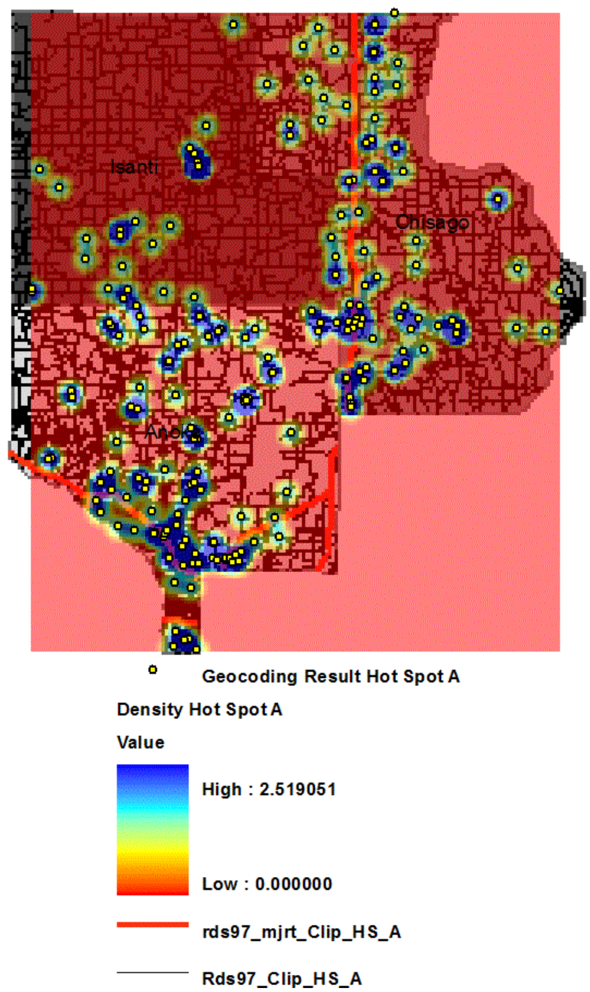

Figure 11. Hot Spot A density distribution illustrating clusters of Meth Events.

HS Analysis Performed: Kernel Density

distribution of ME's based on 2 standard deviations, 2000m range, 100 m grid.
Observations: A majority of the ME's in Chisago and Isanti counties straddle I-35, most within 5 miles of the major roadway. The exception was a heavy clustering around the Chisago City area where many of the dozens of small towns and cities are approximately 3 to 4 miles apart. Isanti County exhibited a smaller clustering around the city of Cambridge. Anoka County ME's tended to be concentrated about the junction of Highway 10 and I-35W and were substantial in number. This particular area is in the inside rim of the commuter zone, where the average drive time to work is around 25 minutes. The remaining ME's in Anoka County tended to be evenly distributed throughout the county as opposed to the ME's of western Chisago County, which heavily gravitated around the small cities of Stacy, Wyoming, and Forest Lake. The small towns found north of this area on I-35 exhibited the same small clustering in direct proportion to the populations of the towns. In general, the ME's throughout the overall hot spot show a type of "hub and spoke" pattern, with the longest spokes protruding outward along major roadways following population densities. Overall, Hot Spot A has the highest risk factor of the three hot spots analyzed, and the area is statistically the biggest threat for ME's and future Meth-related crime in the state.

Hot Spot B

Counties: Blue Earth, Le Sueur, Nicollet.
Key Cities: Mankato (pop. 32,427), North Mankato (pop. 11,798), St. Peter (pop. 9,747).
Total Counties Population: 111,138
ME's: 103 as illustrated in Figure 12.
Manually Located: 99
Unable to Locate: 4
Locating Percent: 96 %
Major Transportation Routes: US-14, US-169 S., and State Hwy. 60
Nearby Waterways: Minnesota River.
HS Analysis Performed: Density distribution of ME's based on Classified (4 categories) 1 standard deviation.
Observations: A vast majority of the ME's found in Blue Earth County were near or within the city limits of Mankato and North Mankato. This is mostly likely due to the fact that the two cities population adds to less than 45K and is not considered a metropolitan area but rather a smaller urban area. The ME's found north of the this urban area religiously "hugged" US-169 along the Le Sueur and Nicollet Counties shared border with a majority falling within 5 miles of the highway. Also, the Minnesota River follows this same path, but is an unlikely factor in the distribution besides the fact a large percent of the population out of town lives near the waterway. In Blue Earth County, only a dozen or so ME's have been found and were widely distributed. Nicollet County ME's were found in small clusters near the towns of New Ulm and Nicollet, both of which are located on US-14. Just northeast of Mankato in Le Sueur County, there was a notable cluster of ME's surrounding the city of Le Center, following the similar pattern found near the smaller cities of Hot Spot A. As seen in Figure 12, the ME's of Hot Spot B exhibited the same type of "hub and spoke" pattern as found in Hot Spot A, with two more exaggerated spokes following US-169 and roads leading to Le Center.

The center of the hub contained many ME's concentrated in the

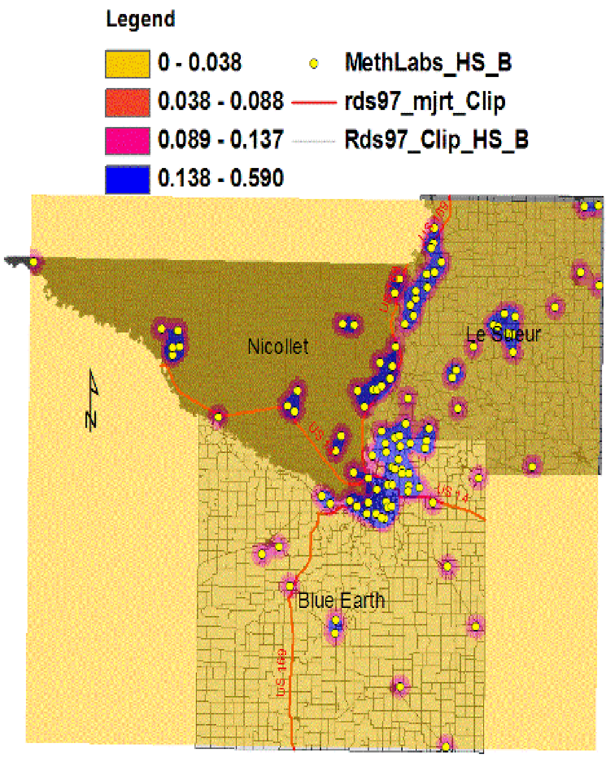

Figure 12. Hot Spot B density distribution.

Mankato area. Overall, Hot Spot B had the third-highest risk factor of the three hot spots analyzed and the area is statistically the greatest threat for ME's and related crime in the southwest area of the state.

Hot Spot C

Counties: Dodge, Olmsted, Wabasha.
Key Cities: Rochester (pop. 85,806), Wabasha (pop. 2,599)
Total Counties Population: 163,618
ME's: 200 as shown in Figure 13.
Geocoded and Matched: 157
Geocoded and Unmatched: 43
Successful Geocoding Percent: 76%
Ammonia Thefts:
Manually Matched: 17
Potential ME Theft Suspects: 10
Major Transportation Routes: I-90, US-52, US-63, and US-14.
Near-by Waterways: Zumbrota River.

HS Analysis Performed: Point shapefile density display of ME's, Ammonia Thefts, and potential ME's responsible for thefts based on a selection by location of ME's to theft locations within 5280 feet (1 mile) as illustrated in Figure 13. ME's were geocoded, while Ammonia Thefts were manually located by using online mapping tools, latitude-longitude information, and additional crossroad information.
Observations: The distribution of ME's was highly concentrated within central Olmsted County and many were found within the city limits of Rochester. Dodge County contained less than a few dozen ME's, while most were segregated and redefined as ammonia thefts found along the eastern border with Olmsted County. Again, the ME's follow along major highways US-52, US-14, US-63 and I-90, but the spokes were more fragmented and less continuous as opposed to the continuous spokes of Hot Spots A and B. Wabasha County ME's were primarily clustered around the Zumbrota area. The center of the pattern was comprised of a heavy concentration of ME's near and within Rochester similar to that observed in the Mankato area of Hot Spot B. The Ammonia Theft sites were mainly found in two groupings, one to the east of the city and one to the west – both approximately 20 minutes travel time by automobile outside of Rochester. This fact tends to reflect the fact that anhydrous ammonia is mostly found in rural areas and that thieves are typically traveling away from the city to commit the crimes. The most likely thieves, if using distance as a primary-weighted factor, tended to be relatively close to the crime scenes (farms) and were able to transport the chemicals more easily. Also, the potential offenders are taking less risk of

being arrested by traveling into the city where a denser law enforcement presence exists. The ME's of Hot Spot C exhibited a central clustering tendency, while the Ammonia Thefts were located to the east and west of the city of Rochester. Overall, Hot Spot C had the second-highest risk factor of the three hot spots under analysis. The area is statistically the greatest threat for ME's and related crime in the southeastern part of the state. Refer to Figure 13 for further clarification of the observations derived from the Hot Spot C map.

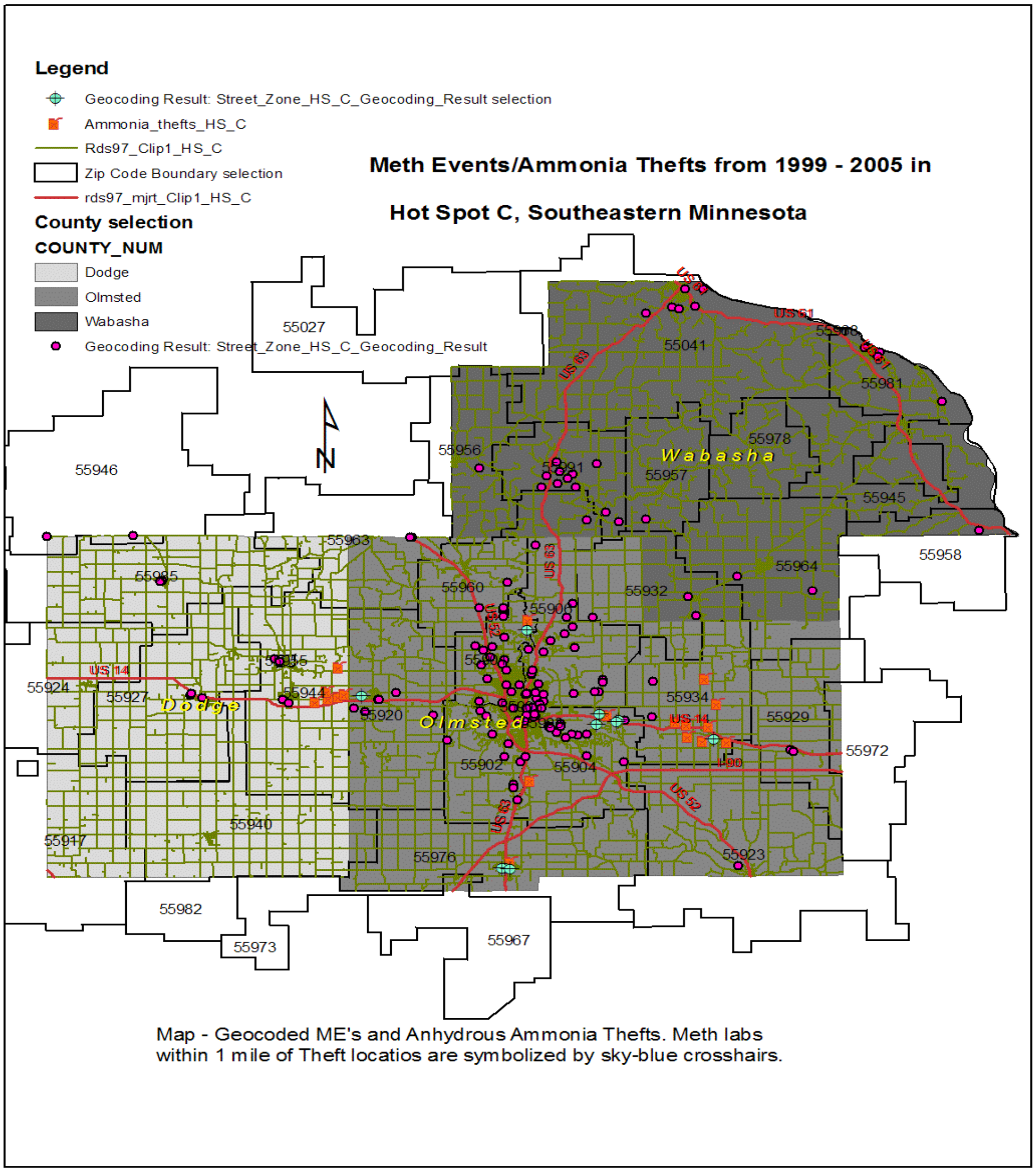

Figure 13. Hot Spot C Meth Events and Anhydrous Ammonia Theft Distribution, 1999-2005.

Creation of the Minnesota Risk Model

The development of the Risk Model required the use of the ESRI ArcGIS Spatial Analyst extension. The procedure was a four step process:

1) Inputting and classifying datasets
2) Converting layers; vector to raster
3) Reclassifying the datasets
4) Weighting and combining datasets

<u>1) Inputting and classifying datasets</u>
Fortunately, the nine datasets (RF-1 through RF-9) representing the risk factors as layers have been added and originally classified. Unfortunately, they are in vector format and required conversion to raster format.

<u>2) Converting layers; vector to raster</u>
Each of the nine layers was converted from vector to raster using Spatial Analyst.

<u>3) Reclassifying the datasets</u>
Each layer or dataset was reclassified to a common scale, 1 to 5, and standard color scheme, green to red. The higher values and red tones represent higher risk areas.

<u>4) Weighting and combining datasets</u>
If all the layers have the same "impact" on the overall model, weighting would not be required. In the case of the risk model being created, each of the risk factors have different weights, which can be applied based on the correlation coefficients as determined during the crime data and risk factor analysis. The layers are assigned a weight, or percent influence, and the sum of the weights is "1" (or 100%, because each percentage is divided by 100 to normalize values). The following table displays the weights of each risk factor, followed by a coefficient of correlation of that factor's array of values as compared to the ME array as determined during preliminary data analysis as viewed in Table 6.

Table 6. Weights assigned to model risk factors.

Risk Factor	Corr. Coeff.	Weight
RF-1	.354	.17
RF-2	.136	.15
RF-3	.007	.05
RF-4	.346	.23
RF-5	-.077	.08
RF-6	.154	.12
RF-7	.015	.02
RF-8	-.113	.10
RF-9	.082	.08

It should be noted that other features of the risk factors were taken into account while determining weight; the weight was not solely determined by the correlation coefficient. Other influential factors included news reports of crime and Meth in specific geographic areas as well as information garnered from local authorities.

Using Spatial Analyst, each layer was multiplied by the assigned weight, and summed with the product of the remaining factors and their weights. The following equation is an example of the operation performed:

[Reclass_RF-1] * .17 + [Reclass_RF-2] * .15 + [Reclass_PF-3] * .05 + [Reclass_RF-4] * .23 + [Reclass_RF-5] * .08 + [Reclass_RF-6] * .12 + [Reclass_RF-7] * .02 + [Reclass_RF-8] * .10 + [Reclass_RF-9] * .08

The result of the grid statement created a single layer composed of the nine individual raster layers, which was processed using map algebra with the different weights of risk exemplified in Figure 14 below. The red areas are high risk and the green areas are low risk.

Validation of Risk Model

Two methods were used to validate

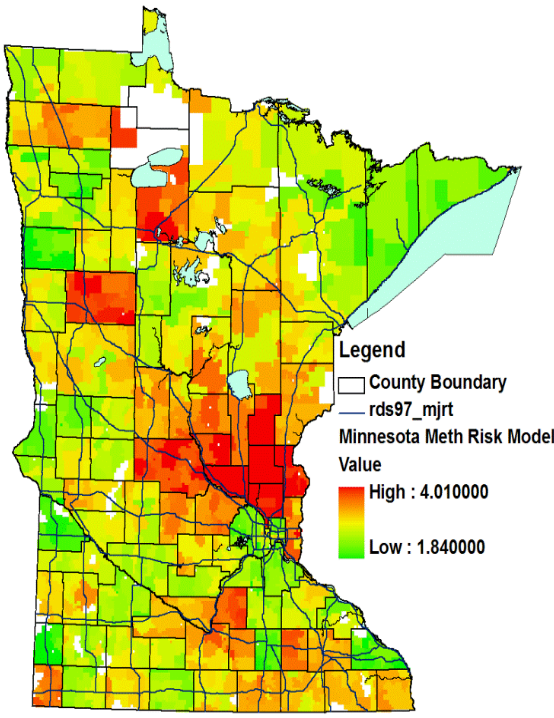

Figure 14. Minnesota Methamphetamine Risk Model, projected through 2009.

the Risk Model, 1) a count of ME's located within the range of risk areas, extreme to insignificant, shown in Figure 15, and 2) a visually cross-referenced pair of datasets, yielding an observation of a resultant color (purple) between the converted ME Dot-Density distribution, to raster, and an existing Risk Model layer as shown in Figure 16.

As illustrated in Figure 15, the following counts per classification were observed:

285 ME's: Extreme Risk Areas (Black)
330 ME's: High Risk Areas (Dark Gray)
199 ME's: Medium Risk Areas (Gray)
131 ME's: Medium Low Risk (Lt. Gray)
79 ME's: Minimal Risk Areas (White)
1024 Total ME's

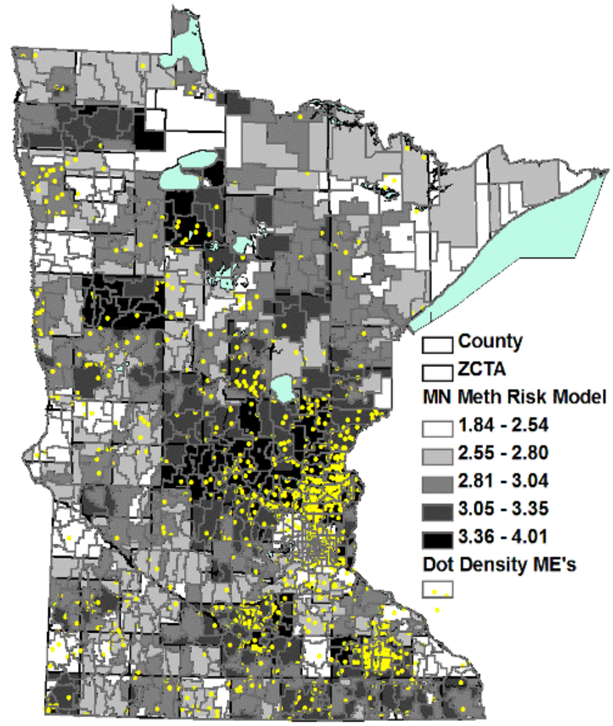

Figure 15.Visual cross reference Risk Model, Black to White risk levels and Yellow ME's.

The visual interpretation of the Meth Events layer and the Risk layer supports the model in the sense that the high risk areas correspond with the Meth Events layer concentrations geographically.

Visual Cross-Reference

The areas with the deepest hue of purple are the result of high-risk and high-ME's. Because the high risk levels of these areas correlate with the high number of ME's, the risk factors chosen for the model are statistically reinforced. The factors used in developing the model, as defined earlier, are based on demographic and socio-economic datasets.

The overlapping of deep red and deep blue colors result in dark purple patches. These areas of overlap occurred over known hot spots and high crime areas as portrayed in Figure 16.

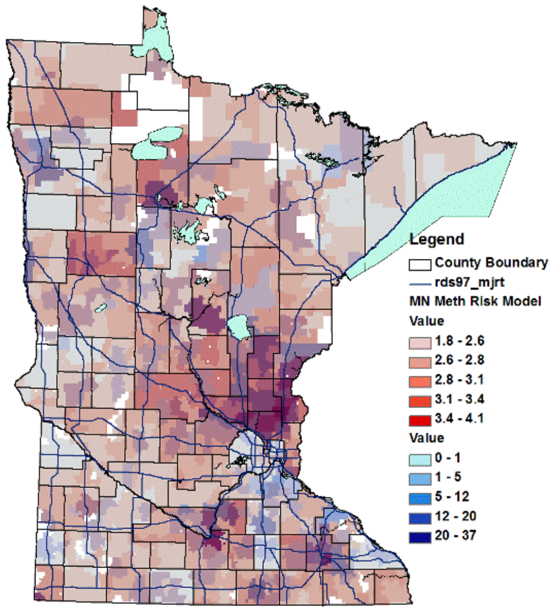

Figure 16.Visual cross reference Risk Model, Red – Blue overlap, Purple Hot Spots.

This suggests that the factors with the most impact were chosen and appropriately weighted. One can ascertain that high crime rates and Meth related events go hand-in-hand, or better said, are found in common areas with similar features. The increase in crime rates is primarily a result of Meth activities.

Final Analysis

The top ten highest-risk counties and key cities in Minnesota for Meth-related crime, in ascending order, are provided in Table 7. Hot Spots A, B, and C contain 550 out of approximately 1244 ME's, with the 9 counties accounting for 44% of statewide Meth Events.

Referring to Appendix A, the mean Overall Crime Rate is 7966 for Hot Spot areas, and 7361 for All Counties, or about 8% higher over a 7 year period. The Narcotics Crime Rate remained virtually

Table 7. Top 10 High-Risk Counties and Cities.

County	**Key City**
Olmsted	Rochester
Chisago	Forest Lake
Anoka	Northern Suburbs
Blue Earth	Mankato
Beltrami	Bemidji
Isanti	North Branch
Crow Wing	Brainerd
Sherburne	St. Cloud
Stearns	Sauk Center
Wright	Buffalo

the same over the same period, essentially reinforcing the fact that marijuana is a 75% contributor to the statistic while metropolitan counties make up a larger portion of all narcotics-related crime. The ME Crime Rate is 108 for Hot Spot counties compared to 41 in All Counties, equating to 84 and 26 ME's per 100,000 persons respectively.

Over a 7 year period, averaging 1-year leading, same year, and 1-year lagging statistics, the crime rates of specific offense types that have the strongest correlation to Meth abuse and production are listed in Table 8. This data was derived from data found in Appendix B.

Table 8. All Hot Spots (A, B, & C) average correlation coefficients over 7-year period.

Offense Type	**Avg.Corr.Coeff.**
Family/Children	.632
Burglary	.508
Agg. Assault	.347
Rape	.345
Forgery Fraud	.339
Other Assaults	.303
Other Sex	.280

The number of Meth Events/Labs peaked in 2003 with 301 being discovered. The number of ME's has been slowly declining over the past three years. The factors used in the risk model development, based on the validation process, are appropriately selected and weighted based on the successful alignment of risk layers and ME layers.

Discovery and Findings

The Minnesota Risk Model scored semi-urban counties higher than rural because of the trend of Meth moving towards counties containing mid-sized urban centers. This change in weighting appears to be accurate and is validated by ME locations within the Minnesota model.

The Minnesota model exhibits two main Hot Spots B and C that are approximately 50 and 40 miles from the Iowa border. The State of Iowa "busted" 578 labs in the year 2001 and 861 labs in 2002, a 49% increase. In the same time frame, Minnesota exposed 154 labs and 250 labs, an increase of 63%. Clearly, Meth-riddled states located to the south and west of less inflicted states have a severe and negative impact upon their northern and eastern neighbors (ISP, 1999).

The overall impact that the various risk factors contributed to the creation of the Model are as follows. The top three factors exhibiting the strongest levels of correlation to Meth-related events are factors RF-1 (drive-t), RF-4 (urban-rural) and RF-6 (% 25-34). These are followed closely by the moderately deterministic factors RF-2 (%OCR), RF-7 (% white), and RF-9 (% unmarried). The remaining factors had little or no deterministic value, those being RF-3 (%NCR), RF-5 (% poverty), and RF-8 (% no HS diploma).

Findings suggest a majority of Meth related abuse is located near cities, or urban centers, having a population of between 35,000 and 75,000 and/or within 30 minutes of a metro area having in excess of 300,000 people.

A study performed by Max Lu (Lu and Burnum, 2006), professor of Geography at Kansas State, tends to support the findings of this Minnesota research project. Lu performed case studies of both urban areas, Colorado Springs, CO (pop. 360,000) and rural areas of Kansas. In the urban setting, the results of mapping were consistent with the 25-28 minute drive time to a major urban area clusters, as well as the hub and spokes distribution of ME's in hot spots as previously defined. The distribution of ME's in, and just outside of Colorado Springs straddled major roadways I-25, US-24, and State Highway 24. The Kansas study revealed three hot zones, linear in nature, with non-random and more diffuse patterns of ME points. The three elongated zones are A) along I-70 from Kansas City to Topeka (23 miles), B) straddling I-135 from Wichita extending to Salina (92 miles), and C) from Wichita to the Great Bend area along State Highway 96 (approx. 75 miles). Lu's Hot Zones A, B, and C each have similar features and distribution characteristics of ME's to the Minnesota Hot Spots A, B, and C respectively. The Minnesota model did not incorporate all of the same risk factors as Lu's study, but the similarities of Lu and Burnum's results and the results of this research may indicate the subtle differences between Meth out West and Meth in the Midwest (KSU, 2006).

Discussion

Meth, sometimes referred to as "poor man's cocaine," has been displacing and replacing cocaine in rural and semi-urban areas of Minnesota. The scourge has burdened society, from the personal to the professional echelons, with nearly immeasurable suffering and pain at the physical, psychological, emotional, spiritual, and financial levels. Specific crime rates have risen, or at a minimum, not fallen at the same rate found in mid-to-low risk counties of the state. Many different demographic and socio-economic factors can be chosen to base an analysis upon, and each can be weighted differently while creating the Risk Model. The demographic factors included in this study were chosen based on prior empirical research, as well as the preliminary evaluation of a multitude of factual sources: drug treatment professionals, interventionists, counselors, police officers, recovering Meth addicts, and grieving mothers.

The geographic units used in this study, Zip Code Tabulation Areas and Counties, allowed for the analysis at a fine level and also at a coarse level respectively. The ZCTA units were small enough to obtain general locations where hot spots have been developing from 2000 to 2005. By examining counties, the area unit that crime data is collected in the UCR's, also provided pertinent information to local officials and law enforcement, as the county is also a unit of government. Budgets and responsibilities are drawn at the county level, while the ability to focus on crime and Meth labs require the incorporation of the much smaller and numerous ZCTA's.

Much of the data used throughout the analysis, specifically crime rates and ME's from 2006 and 2007, was interpolated using linear best-fit functions. There is no solid way to determine the positive or negative effects of legislation, education, and community efforts regarding the future state of our communities in regards to Meth.

In retrospect, several additional factors may have been used to achieve more accurate results. Perhaps, comparing rental-to-owned property ratios or creating a layer of Section 8 housing would have been more "telling" factors in the model. Per Rob Zink (2006), a St. Paul Police Officer, those people living in areas having high percentages of Section 8 housing are responsible for 80-90% of the crime in urban areas. Possibly weighting urban areas heavier than rural or semi-urban areas as Lu (2006) used in his studies may have resulted in a more modern determination of high-risk areas.

Many comparative software packages and statistical methods, such as LISA (Local Indicators of Spatial Statistics), GeoDa, SpaceStat, CrimeStat III, can be used to achieve similar research and crime mapping results as ESRI products – namely ArcView Spatial Analyst. Coupling a statistical package, such as MiniTab, SPSS, or simply MS Excel can provide delineation between the GIS and statistical computations.

The findings and discoveries offered at the conclusion of this project are a product of processing 80% tangible, quantifiable facts and data along with 20% intangible, unquantifiable conjecture. The latter 20 percent represents a weakness in the Risk Model analysis and discovery process, limiting the model's usage to that of a guide for law enforcement, public health professionals, and policy makers. It is unexplainable why some geographic areas and communities are adversely affected by the epidemic of Methamphetamine and yet others are spared, but we – as inquisitive and ever questioning humans - must continue to look for answers in the form of numbers, patterns, trends, and above all, maps.

Acknowledgements

The positive input and valiant efforts of the following individuals significantly added to the quality and validity of the research project outlined within this document. Appreciation and "Thanks" go out to Paul Stevens (BCA), John Ebert (SMU-GIS Director), Debra Durkin (MDH), and Boyd Butler (ISP).

References

Alsobrooks, D. 2002. Drug Abuse Causes Crime. In J. Torr (Ed.), Opposing Viewpoints: Crime and Criminals (pp. 52-60). Greenhaven Press.

Becker, Amy 2004. Archive: The Meth Effect. St. Paul Pioneer Press, Feb. 22, 2004. Retrieved on Sept. 10, 2006.

Boyum, D. and Kleiman, M. 2003. Breaking the drug-crime link. Public Interest; Summer 2003 Issue 152 (pp. 19-20). Retrieved on Aug. 21, 2006, from EPNet.

Butler, Boyd W. 2000. Mapping in Action: Illinois Methamphetamine Risk Model. Crime Mapping News, Fall 2000 (pp.8-9). Police Foundation.

Clark, V. 2005. Meth Boiled Down. IQ – Initiative Quarterly, Fall 2005 (pp.10-13). Initiative Foundation (IF).

CJIS 2004. Uniform Crime Reporting Handbook, 2004. USDOJ, www.usdoj.gov/dea

Durkin, D. 2006. Lab Events Database. Retrieved from MDH, April 7, 2006. Methamphetamine and Meth Labs. Retrieved from www.health.state.mn.us on Nov. 11, 2006.

ISP - Illinois State Police 1999. 1999 Annual Methamphetamine Report. Illinois State Police Department.

Johnson, D. 2005. Meth: The Home-cooked Menace. Center City, Minnesota: Hazelden Foundation.

KSU – Kansas State University 2006. Geography and Geospatial Technology Used To Study Patterns of Seized Meth Lab. Editor. ScienceDaily, Sept. 8, 2006. Retrieved Dec. 14, 2006 from www.sciencedaily.com/releases.

Kyle, A. and Hansell, B. 2005. The Meth Epidemic in America: Two Surveys of U.S. Counties. Survey conducted by Research, Inc. and published by the National Association of Counties, NACo. www.naco.org. Retrieved on Dec. 2, 2005, from EBSCO MegaFILE.

Lu, M. and Burnum, J. 2006. Spatial Analysis of Clandestine Methamphetamine Labs. Abstract – Submitted to NIDA/AAG, Submitted to NIDA/AAG, March 8, 06. www.aag.org/nida-aag/research.

Mills, K. 1999, Dec. 13. Meth of old has morphed into epidemic proportions. Seattle Post-Intelligencer. Retrieved Dec. 2, 2005, from www.kci.org.

NIJ 2005. Special Report - Mapping Crime: Understanding Hot Spots. Retrieved from www.ojp.usdoj.gov/nij on Feb. 14, 2007.

ONDCP 2005. Office of National Drug Control Policy, State of Minnesota Profile of Drug Indicators, June 2005. Retrieved Aug. 2, 2006, from ONDCP. www.aag.org/nida-aag/research.

SAMHSA 2006. Substance Abuse and Mental Health Services Administration Treatment Episode Data Set (TEDS) 1994-2004. Department of Health and Human Services, www.samhsa.gov.

Shroyer, J. 2005. The Meth lab next door. IQ – Initiative Quarterly, Fall 2005, (pp.15-17). Initiative Foundation (IF).

Stevens, P. 2005. Minnesota ICE Academy Lecture, Nov. 1, 2005. Paul Stevens, formerly with the MN BCA.

Zink, R. 2006. St. Paul Police Department. Personal interview on Feb. 3rd , 2006.

Appendix A. Crime Rates to Meth Events Comparison, All Counties, Hot Spots, and All Hot Spots Counties.

Unit	Average						Ratio
	OCR	NCR	% Chg OCR	% Chg NCR	MEs	MECR	ME /100K
All Counties	7361	299	90	117	15	44	26
Hot Spot A	8549	369	103	127	83	120	66
Hot Spot B	9317	200	99	98	33	105	88
Hot Spot C	6030	312	82	97	54	99	96
All HS Counties	7966	294	95	108	57	108	84

Appendix B. Specific Crime Rates to Meth Events Comparison, All Hot Spots, averaged 3-year.

HotSpot	**A,B, C Totals**									Same Yr ME - CR Corr. Cf.	1-Yr ME Lead CR Corr. Cf.	1-Yr ME Lag CR Corr. Cf.
	Offense	Year										
Part I		2000	2001	2002	2003	2004	2005	2006	2007			
	Rape	353	343	361	405	320	373	354	356	**0.588**	-0.252	0.194
	Agg. Assault	689	689	600	689	499	703	674	662	-0.231	**-0.583**	-0.227
	Burglary	3083	3220	3213	3342	3424	3336	3126	3188	**0.607**	**0.840**	0.079
Part II	Other Assaults	4131	4634	4588	4684	4579	4919	4313	4431	**0.384**	0.234	0.292
	Forgery/Fraud	4640	5651	5686	5670	5455	5776	5117	5272	**0.445**	0.000	**0.571**
	Other Sex	778	619	760	741	605	647	743	721	0.137	**-0.520**	0.183
	Family/Children	943	1284	1656	1213	980	1067	1243	1221	0.162	**-0.789**	**0.945**
	Meth Events	15	6	109	236	115	60	42	62